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(54) **SHEET-LIKE COMPOSITE**

ZUSAMMENGESETZE FOLIE

MATERIAU COMPOSITE ANALOGUE A UNE FEUILLE

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width between the opposite elongate side surface portions of the strands along the bonding locations than between the bonding locations to provide very firm attachment between the first sheet and the strands. The sheet-like composite can be stretched longitudinally of the elastic strands without breaking that attachment so that the normally arcuate portions of the sheet material or sheet materials can lay along the side surface of the strands. During such stretching, the sheet-like composite according to the present invention provides the advantage that it will retain its width in a direction transverse to the strands instead of necking down or become narrower at its midsection in a direction transverse of the strands (i.e., such narrowing will occur in elastic sheet-like composites which have a resilient sheet instead of the spaced strands bonded to the anchor portions of the flexible sheet material). The resilient strands will retain a tension in the elastic sheet-like composite while they are stretched, and when the sheet-like composite is released, will recover to their normal length to again cause those normally arcuate portions of the first sheet material to again be arcuate.

[0010] In the method described above for forming an sheet-like composite the forming step can comprise the steps of (1) providing first and second generally cylindrical corrugating members each having an axis and including a multiplicity of spaced ridges defining the periphery of the corrugating member, the ridges having outer surfaces and defining spaces between the ridges adapted to receive portions of the ridges of the other corrugating member in meshing relationship with the sheet of flexible material therebetween; (2) mounting the corrugating members in axially parallel relationship with portions of the ridges in meshing relationship; (3) rotating at least one of the corrugating members; (4) feeding the sheet of flexible material between the meshed portions of the ridges to generally conform the sheet of flexible material to the periphery of the first corrugating member and form the arcuate portions of the sheet of flexible material in the spaces between the ridges of the first corrugating member and the anchor portions of the sheet of flexible material along the outer surfaces of the ridges of the first corrugating member; and (5) retaining the formed sheet of flexible material along the periphery of the first corrugating member for a predetermined distance after movement past the meshing portions of the ridges; and the extruding step includes providing an extruder that, through a die with spaced openings, extrudes the spaced strands of molten thermoplastic material onto the anchor portions of the sheet of flexible material along the periphery of the first corrugating member within the predetermined distance. This method allows the diameter of the strands to be easily varied by either changing the pressure in the extruder by which the strands are extruded (e.g., by changing the extruder screw speed or type) and/or by changing the speed at which the first corrugating member, and thereby the first sheet material, is moved (i.e., for a given rate of output from the extruder, increasing the speed the first sheet material is moved will decrease the diameter of the strands, whereas decreasing the speed at which the first sheet material is moved will increase the diameter of the strands). Also, the die through which the extruder extrudes the thermoplastic material can have an easily changeable die plate in which are formed a row of spaced openings through which the strands of molten thermoplastic material are extruded. Such die plates with openings of different diameters and different spacings can relatively easily be formed by electrical discharge machining to afford different spacings and diameters for the strands. Varied spacing and/or diameters for the openings along the length of the row of openings in one die plate can be used, for example, to produce an sheet-like composite which, when stretched longitudinally of its strands, will be under greater tension adjacent its edges parallel to the strands than at its mid portion between those edges because of larger or more closely spaced strands adjacent its edges. Similar effects can be achieved by shaping and or modifying the die to form hollow strands, strands with shapes other than round (e.g., square or + shaped) or by-component strands.

[0011] As indicated above, the sheet-like composite according to the present invention can further include a second sheet of flexible material having anchor portions thermally bonded at second sheet bonding locations to longitudinally spaced parts of the strands along corresponding second elongate surface portions thereof, and having arcuate portions projecting from the second elongate surface portions of the strands between the second sheet bonding locations.

[0012] Using the method described above, such a second sheet of flexible material can be provided in the sheet-like composite in at least two different ways. One way is to form the second sheet of flexible material to have arcuate portions projecting in the same direction from spaced anchor portions of the second sheet of flexible material; and positioning the spaced anchor portions of the second sheet of flexible material in closely spaced opposition to the spaced anchor portions of the first sheet of flexible material with the arcuate portions of the first and second sheets of flexible material projecting in opposite directions so that the spaced generally parallel elongate strands of molten thermoplastic material are extruded between and onto the anchor portions of both the first and second sheets of flexible material to form resilient strands bonded to and extending between the anchor portions of both the first and second sheets of flexible material. Another way is to provide a second sheet of stretchable flexible material that, when stretched, will retain most of the shape to which it is stretched; and to position one surface of the second sheet of flexible material in closely spaced opposition to the spaced anchor portions of the first sheet of flexible material on the side of its spaced anchor portions opposite its arcuate portions so that the spaced generally par-

lidifying the strands.

[0018] The present invention will be further described with reference to the accompanying drawing wherein like reference numerals refer to like parts in the several views, and wherein:

Figure 1 is a schematic view illustrating a first embodiment of a method and equipment according to the present invention for making a first embodiment of an sheet-like composite according to the present invention;
Figure 2 is a perspective view of the first embodiment of the sheet-like composite according to the present invention made by the method and equipment illustrated in Figure 1;
Figure 3A is a fragmentary enlarged sectional view taken approximately along line 3A-3A of Figure 2;
Figure 3B is a fragmentary enlarged sectional view taken approximately along line 3B-3B of Figure 2;
Figure 4 is a schematic view illustrating a second embodiment of a method and equipment according to the present invention for making a second embodiment of an sheet-like composite according to the present invention;
Figure 5 is a perspective view of the second embodiment of the sheet-like composite according to the present invention made by the method and equipment illustrated in Figure 4;
Figure 6 is a fragmentary enlarged sectional view taken approximately along line 6-6 of Figure 5;
Figure 7 is a fragmentary front view of a die plate included in the equipment illustrated in Figures 1 and 4;
Figure 8 is a fragmentary sectional view similar to that of Figure 6 which illustrates possible variations in the size and spacing of strands included in the sheet-like composite;
Figure 9 is a schematic view illustrating a third embodiment of a method and equipment according to the present invention for making the second embodiment of the sheet-like composite according to the present invention illustrated in Figure 5;
Figure 10 is a schematic view illustrating a fourth embodiment of a method and equipment according to the present invention for making a third embodiment of the sheet-like composite according to the present invention;
Figure 11 is a fragmentary view taken approximately along line 11 of Figure 10;
Figure 12 is a schematic view illustrating a fifth embodiment of a method and equipment according to the present invention for making the first embodiment of the sheet-like composite according to the present invention illustrated in Figures 2 and 3;
Figure 13 is a plan view of a first embodiment of a disposable garment or diaper incorporating sheet-like composite according to the present invention;
Figure 14 is a perspective view of an assembly from which can be made a second embodiment of a disposable garment (i.e., a diaper or training pants) incorporating sheet-like composite according to the present invention;
Figure 15 is a schematic view illustrating a sixth embodiment of a method and equipment according to the present invention for making a fourth embodiment of the sheet-like composite according to the present invention;
Figure 16 is a perspective view of the fourth embodiment of the sheet-like composite according to the present invention made by the method and equipment illustrated in Figure 15;
Figure 17 is a perspective view of a fifth embodiment of the sheet-like composite according to the present invention that can be made by the method and equipment illustrated in Figure 15; and
Figure 18 is a schematic view illustrating a sixth embodiment of a method and equipment according to the present invention for making sixth and seventh embodiments of the sheet-like composite according to the present invention.

[0019] Referring now to Figure 1 of the drawing, there is schematically illustrated a first embodiment of a method and equipment according to the present invention for making a first embodiment of an sheet-like composite 10 according to the present invention which is illustrated in Figures 2 and 3.

[0020] Generally the method illustrated in Figure 1 involves providing a first sheet 12 of flexible material; forming the first sheet 12 of flexible material to have arcuate portions 13 projecting in the same direction from spaced anchor portions 14 of the first sheet 12 of flexible material; extruding spaced generally parallel elongate strands 16a of molten thermoplastic material that is resilient when cooled onto the anchor portions 14 of the first sheet 12 of flexible material to form resilient strands 16 thermally bonded to and extending between the anchor portions 14 of the first sheet 12 of flexible material with the arcuate portions 13 of the first sheet 12 of flexible material projecting from corresponding elongate surface portions 18 of the strands 16; and cooling and solidifying the strands 16.

[0021] As illustrated in Figure 1, the equipment for performing the method includes first and second generally cylindrical corrugating members 20 and 21 each having an axis and including a multiplicity of spaced ridges 19 defining the periphery of the corrugating member 20 or 21, the ridges 19 having outer surfaces and defining spaces between the ridges 19 adapted to receive portions of the ridges 19 of the other corrugating member in meshing relationship with the first sheet 12 of flexible material therebetween; means for mounting the corrugating members 20 and 21 in axially parallel relationship with portions of the ridges 19 in meshing relationship; means for rotating at least one of the corrugating members 20 or 21 so that when the first sheet

viding a second sheet 32 of material (e.g., polymeric or other material that could be a sheet or film or could be a nonwoven layer); forming the second sheet 32 of material to have arcuate portions 33 projecting in the same direction from spaced anchor portions 34 of the second sheet 32 of material; and positioning the spaced anchor portions 34 of the second sheet 32 of material in closely spaced opposition to the spaced anchor portions 14 of the first sheet 12 of flexible material with the arcuate portions 13 and 33 of the first and second sheets 12 and 32 of material projecting in opposite directions; and the extruder die 23 extrudes the spaced generally parallel elongate strands 16a of molten thermoplastic material between and onto the anchor portions 14 and 34 of both the first and second sheets 12 and 32 of material to form resilient strands 16 bonded to and extending between the anchor portions 14 and 34 of both the first and second sheets 12 and 32 of material with the arcuate portions 13 and 33 of the first and second sheets 12 and 32 of material projecting in opposite directions from opposite corresponding first and second elongate side surface portions 18 and 28 of the strands 16.

[0025] The equipment illustrated in Figure 4, in addition to the first and second corrugating members 20 and 21, and the extruder 22 which are operated in the manner described above with reference to Figure 1, further includes third and fourth generally cylindrical corrugating members 36 and 37 each having an axis and including a multiplicity of spaced ridges 38 defining the periphery of the corrugating member 36 or 37, the ridges 38 having outer surfaces and defining spaces between the ridges 38 adapted to receive portions of the ridges 38 of the other corrugating member 36 or 37 in meshing relationship with the second sheet 32 of flexible material therebetween; means (which could be provided by a frame, not shown) for mounting the third and fourth corrugating members 36 and 37 in axially parallel relationship with portions of the ridges 38 in meshing relationship; means for rotating at least one of the third and fourth corrugating members 36 and 37 so that when the second sheet 32 of material is fed between the meshed portions of the ridges 38 the second sheet 32 of material will be generally conformed to the periphery of the third corrugating member to form arcuate portions 33 of the second sheet 32 of material in the spaces between the ridges 38 of the third corrugating member 36 and to form anchor portions 34 of the second sheet 32 of material along the outer surfaces of the ridges 38 of the third corrugating member 36; and means (i.e., including the surface of the third corrugating member 36 being texturized or roughened by being sand blasted or chemically etched and being heated to a temperature generally in the range of -5.5 °C to 63.8 °C (25 to 150 Fahrenheit degrees) above the temperature of the first sheet 32 of flexible material) for retaining the formed second sheet 32 of material along the periphery of the third corrugating member 36 for a predetermined distance after movement past the meshing portions of the ridges 38 of the third and fourth corrugating members 36 and 37. The third corrugating member 36 is positioned in spaced relationship from the first corrugating member 20 so that the extruder die 22 positions the molten strands 16a on the anchor portions 14 and 34 of both the first and second sheets 12 and 32 of material along the peripheries of the first and third corrugating members 20 and 36 within the predetermined distance. Air ducts 39 are provided to blow streams of cool air against opposite sides of the sheet-like composite 30 to solidify the strands 16a and the bond between the strands 16a and the anchor portion 14 and 34 of the sheets 12 and 32.

[0026] The structure of the sheet-like composite 30 made by the method and equipment illustrated in Figure 4 is best seen in Figures 5 and 6. The sheet-like composite 30 comprises the multiplicity of generally parallel elongate strands 16 of resilient thermoplastic material extending in generally parallel spaced relationship. Each of the strands 16 has opposite elongate side surface portions 26 (See Figure 6) that are spaced from and are adjacent the elongate side surface portions 26 of adjacent strands; and each of the strands 16 also has corresponding opposite first and second elongate surface portions 18 and 28 extending between its opposite elongate side surface portions 26. The spaced anchor portions 14 of the first sheet 12 of flexible material are thermally bonded at first sheet bonding locations to longitudinally spaced parts of the strands 16 along their first elongate surface portions 18, and the arcuate portions 13 of the first sheet 12 of flexible material project from the first elongate surface portions 18 of the strands 16 between the first sheet bonding locations. The second sheet 32 of material has its spaced anchor portions 34 thermally bonded at second spaced sheet bonding locations to longitudinally spaced parts of the strands 16 along their second elongate surface portions 28, and has its arcuate portions 33 projecting from the second elongate surface portions 28 of the strands 16 between the second sheet bonding locations. The first and second sheet bonding locations are opposed to each other, are spaced about the same distances from each other, and are aligned in generally parallel rows extending transverse of the strands 16 to form continuous rows of the arcuate portions 13 and 33 projecting about the same distances from the first and second surface portions 18 and 28 of the strands 16. Because the strands 16 have been extruded in molten form onto the anchor portions 14 and 34 of both the first and second sheets 12 and 32, the molten strands 16 can form around and be indented on opposite sides by the arcuate convex adjacent surfaces of the anchor portions 14 and 34. The bonds between the strands 16 and the anchor portions 14 and 34 at the first and second sheet bonding locations extend along the entire parts of the strand's surfaces that are closely adjacent the anchor portions 14 and 34, which parts can be widened along the surfaces of the anchor portions 14 and 34 by the indentations of the strands 16 by the anchor portions 14 and 34. Thus,

portions of the sheet-like composite 10, and have been given the same reference numerals with the addition of the suffix "c". The method illustrated in Figures 10 and 11 uses some of the same equipment as is illustrated in Figure 1, and similar portions of that equipment have been given the same reference numerals and perform the same functions as they do in the equipment illustrated in Figure 1. The first and second corrugating members 20 and 21 of Figure 1, however, have been replaced by first and second cylindrical corrugating members or rollers 51 and 52 each having an axis and including a plurality of generally annular, circumferentially extending, axially spaced parallel elongate ridges 53 around and defining its periphery, with the ridges 53 having outer surfaces and defining spaces between the ridges 53 adapted to receive portions of the ridges 53 of the other corrugating member 51 or 52 in meshing relationship with the sheet of flexible material 12a between the meshed portions of the ridges 53. The corrugating members 51 and 52 are mounted in axially parallel relationship to mesh portions of the ridges 53 of the corrugating members 51 and 52. While neither corrugating member 51 or 52 need be rotated (i.e., the sheet of flexible material 12c could be pulled between fixed guides shaped like the adjacent and other portions of the corrugating members that are contacted by the sheet of flexible material 12c at any one time), preferably at least the corrugating member 51 is rotated; and the sheet of flexible material 12c is fed between the meshed portions of the ridges 53 of the corrugating members 51 and 52 to generally conform the sheet of flexible material 12c to the periphery of the first corrugating member 51 and form the arcuate portions 13c of the sheet of flexible material 12c in the spaces between the ridges 53 of the first corrugating member 51 and the generally parallel anchor portions 14c of the sheet of flexible material 12c along the outer surfaces of the ridges 53. The formed sheet of flexible material 12c is retained along the periphery of the first corrugating member 51 after separation of the ridges 53; the spaced strands 16c of extruded molten thermoplastic material from the die 23 of extruder 22 are deposited along the formed sheet of flexible material 12c along the periphery of the first corrugating member 51 while the extruder 22 is reciprocated axially of the corrugating members 51 and 52 so that the strands 16c form an undulating or generally sinusoidal or similar pattern with the strands bridging or extending between a plurality of the anchor portions 14c (i.e., at least two and, as illustrated, three anchor portions 14c), so that the molten strands partially envelope and adhere to the arcuate anchor portions 14c of the sheet of flexible material 12c at spaced anchor locations, after which the sheet-like composite 50 is separated from the first corrugating member 51 and carried partially around the cooling roll 24 to complete cooling and solidification of its strands 16c.

[0033] The sheet-like composite 50 made by the method illustrated in Figures 10 and 11 differs from the sheet-like composite 10 made by the method illustrated in Figure 1 in that the rows of bonding locations 18c and the rows of arcuate portions 13c of the sheet of flexible material 12c projecting from the strands 16c extend longitudinally in what is called the machine direction along the sheet-like composite 50 instead of in what is called the cross direction or transversely across the sheet-like composite as do the arcuate portions 13 in the sheet-like composite 10. Also, while the plurality of generally parallel elongate extruded strands 16c of resilient thermoplastic material extend in generally parallel spaced relationship with each of the strands 16c having opposite elongate side surface portions that are spaced from and are adjacent the elongate side surface portions of adjacent strands 16c, the strands 16c extend in a parallel undulating, generally sinusoidal pattern with the strands bridging or extending between a plurality of the anchor portions 14c, rather than in a generally straight lines as do the strands 16 in the elastic sheet-like composite 10.

[0034] Figure 12 illustrates a fifth embodiment of a method and equipment according to the present invention for making the sheet-like composite 10 according to the present invention. The method illustrated in Figure 12 is quite similar to, and uses most of the same equipment as, the method illustrated in Figure 9; and similar portions of that equipment have been given the same reference numerals and perform the same functions as they do in the equipment illustrated in Figure 9. As a modification of the general method steps described above with reference to Figure 9, the method illustrated in Figure 12 does not use either the first sheet 12 of flexible material or the first corrugating member 21. The second sheet 32a of stretchable flexible material that when stretched will retain most of the shape to which it is stretched has one surface placed in closely spaced opposition to the ridges 19 on the ridged corrugating member 20 so that the extruder die 23 extrudes the spaced generally parallel elongate strands of molten thermoplastic material therebetween which are pressed by the ridges 19 onto the adjacent surface of the second sheet 32a of flexible material to form resilient strands 16 bonded to and extending between spaced locations along the surface of the second sheet 32a of flexible material; and then stretching the sheet-like composite 32a longitudinally of the strands 16 after they are cooled and solidified to permanently stretch the second sheet 32a of flexible material so that upon elastic recovery of the strands 16, the second sheet 32a of flexible material will have arcuate portions 33 projecting from corresponding side surface portions 28 of the strands 16. The equipment illustrated in Figure 12 includes the second corrugating member 20, the extruder 22 and extruder die 23, the cooling and nipping rollers 24 and 25 which are operated in the manner described above with reference to Figure 1; the nipping roller 42, the pair of nipping rollers 44 and 45 (the roller 44 may or may not be heated depending on the type of second sheet 32a being proc-

trated in Figure 12. Alternatively if training pants are to be formed, the length 72 and pieces of padding 76 can be folded longitudinally of the length 72 to bring its edges 74 together with the folded padding 76 enclosed by the folded length 72, and portions 80 of the length 72 that will then be adjacent each other on opposite sides of the folded pieces of padding 76 can be attached together adjacent and for a short distance normal to the edges 74 by various means such as adhesives, chemical bonding, heat sealing, sonic welding, etc. The folded length 72 can be cut apart through the sealed portions 80 midway between the adjacent pieces of padding 76 and between the adjacent strips 75 therebetween to form individual training pants, each incorporating one of the pieces of padding 76 and two of the strips 75 around its leg openings.

[0038] Figure 15 illustrates a sixth embodiment of a method and equipment according to the present invention that can be used for making the fourth and fifth embodiments of sheet-like composite 90 and 100 according to the present invention respectively illustrated in Figures 16 and 17.

[0039] The equipment illustrated in Figure 15 includes first and second generally cylindrical bonding rollers 82 and 83 each having an axis and a periphery around that axis defined by circumferentially spaced ridges 85 generally parallel to the axes of the bonding rollers 82 and 83; means such as a frame for the equipment (not shown) for mounting the bonding rollers 82 and 83 in axially parallel relationship with the peripheries of the bonding rollers 82 and 83 defining a nip therebetween; means provided by a pair of sheet compacting devices 86 and 87 (e.g., the devices commercially designated "Micrex/Microcreper" equipment available from the Micrex Corporation, Walpole, MA, which crinkles and compresses the fibers or materials of a sheet to form a sheet that is compacted in a first direction along its surfaces and can be easily expanded in that first direction by partial straightening of the fibers in the sheet) each adapted for receiving a sheet 88 or 89 of flexible material having opposite major surfaces; compacting that sheet 88 or 89 in a first direction parallel to its major surfaces (i.e., along its direction of travel through the device 86 or 87) so that the first and second compacted sheets 91 and 92 have opposite surfaces and can be extended in the first direction along those surfaces in the range of 1.1 to over 4 times its compacted length in the first direction; means for feeding the first and second compacted sheets 91 and 92 of flexible material into the nip in opposed relationship along the surfaces of the first and second bonding rollers 82 and 83; and means in the form of an extruder 83 that is essentially the same as the extruder 22 described above for extruding resilient thermoplastic material to form a multiplicity of generally parallel elongate molten strands 95 of the resilient thermoplastic material extending in generally parallel spaced relationship and for positioning the molten strands 95 between the opposed surfaces of the first and second compacted sheets 91 and 92 of flexible material in the nip between the first and second bonding rollers 82 and 83 with the stands 95 extending in the first direction along the first and second compacted sheets 91 and 92 where the strands 95 are thermally bonded to the first and second compacted sheets 91 and 92 at spaced bonding locations 96 along the strands 95 because of bonding pressure applied by the ridges 85. The sheet-like composite 90 is retained along the periphery of the bonding roller 82 by a guide roller 97, and the bonding roller 82 is cooled (e.g., to 36.1 °C (100 degrees Fahrenheit)) to help solidify the strands 95.

[0040] As with the other sheets of flexible material described above, the compacted sheets 91 and 92 can be formed from many materials including non-woven fibers, or from polymeric film, and when the compacted sheets 91 and 92 and the strands 95 comprise generally the same thermoplastic material, the extruding strands 95 are fused to the compacted sheets 91 and 92 of flexible material.

[0041] The elastic sheet-like composite 90 made by the mechanism illustrated in Figure 15 is illustrated in Figure 16. That sheet-like composite 90 comprises in its un-stretched state (1) a multiplicity of the generally parallel elongate extruded strands 95 of resilient thermoplastic material extending in generally parallel spaced relationship, each of the strands 95 having opposite elongate side surface portions that are spaced from and are adjacent the elongate side surface portions of adjacent strands 95, and each of the strands 95 also having corresponding opposite first and second elongate surface portions extending between the opposite elongate side surface portions; and (2) the first and second compacted sheets 91 and 92 of flexible material having opposite major surfaces, and being compacted in a first direction along those first surfaces so that the first and second compacted sheets 91 and 92 can be extended in the first direction in the range of 1.1 to over 4 times its compacted length (and preferably over 1.3 times its compacted length) in the first direction. Those first and second compacted 91 and 92 are respectively thermally bonded to the first and second elongate surface portions of the strands 95 at the spaced bonding locations 96 with the strands 95 extending in the first direction to afford elastic extension of the strands 95 and the compacted sheets 91 and 92 in the first direction.

[0042] The equipment illustrated in Figure 15 can be operated with only one of the sheets 88 or 89 of flexible material, in which case it will make an sheet-like composite like the sheet-like composite 100 illustrated in Figure 17. That sheet-like composite 100 comprises in its un-stretched state (1) a multiplicity of the generally parallel elongate extruded strands 95 of resilient thermoplastic material extending in generally parallel spaced relationship, and only one compacted sheet 91 or 92 (identified as sheet 91 in the drawing) of flexible material that is compacted in a first direction along its surfaces so that the compacted sheet 91 or 92 can be

27.7̄ °C (85 F). The line speed was about 15 feet per minute, and the melt temperature in the extruder 22 was about 430 F. The sheet of loop material 10 produced was soft, breathable and inexpensive, had arcuate portions 33 projecting from the strands 16 that were 0.012 inch in height and width, was stretchable in the machine direction and had good elastic properties, and did not neck down when extended to straighten the first sheet 12 and to extend the length of the first sheet 12. The sheet of loop material 10 produced would have many uses, including as a side panel and/or as the loop portion of a hook and loop fastener.

[0048] Example 4: Sheet-like composite similar to the sheet-like composite 10 illustrated in Figure 2 was made with the equipment illustrated in Figure 12, except that the two pairs of nipping rollers 44, 45 and 46 were not used. A thermo-plastic rubber commercially available under the trade name "Kraton G1657X" from Shell Chemical Company, A Division of Shell Oil Company, Atlanta, GA, was used in the extruder 22 to form the strands 16. No first sheet 12 was used. About ten strands 16 per 2.54 cm (per inch) of that material that provided a basis weight of 20 grams per square meter of the strand material were applied by the equipment to a second sheet 32a of loop material formed of hydro-entangled Rayon/Polyester with a basis weight 56 grams per square meter commercially available under the trade name "Veratec Versalon" from Veretec, A Division of International Paper, Walpole, MA. That material was compacted approximately 40% (i.e., the compacted material could then be extended to 2.5 times its compacted length) using the Micrex process described above which softened the material and placed a micro structured loop pattern in the cross direction of the non-woven material that allowed for longitudinal stretching of the material and engagement of hooks so that the material provided the loop portion of a hook and loop fastener. The second sheet 32a was bonded at spaced locations to the strands 16 in the nip between the corrugation roll 20 and the smooth chill roll 24 by the ridges 19 of the corrugation member or roll 20. The corrugation roll 20 was at about 108.3̄ °C (230 F), and the chill roll was at about 27.7̄ °C (85 F). The line speed was about 15 feet per minute, and the melt temperature in the extruder 22 was about 216.6̄ °C (425 F). The sheet of loop material produced was initially flat with the entire second sheet 32a lying against the strands 16, but was manually stretch in the machine direction and released so that the strands 16 returned to their original lengths and the portions of the second sheet 32a between the portions thereof attached to the strands 16 formed arcuate portions 13 about 0.3048 mm (0.012 inch) wide at the strands 16 and approximately 0.1524 cm (0.06 inch) in height from the strands 16. Before such stretching, the loop material produced could be wound flat on a roll which produced a roll that was more dense and thus more easily shipped and stored than a roll of the same material after it was stretched and released. The sheet-like composite 10 thus produced was soft, breathable and inexpensive, had good elastic properties, did not neck down when extended to straighten the first sheet 12 and/or to extend the length of the first sheet 12, and was deemed useful as a side panel on a child or adult incontinent diaper or on a training pant, or as the loop portion of a hook and loop fastener, or as an elastic wrap.

[0049] Example 5: An sheet-like composite similar to the sheet-like composite 30 illustrated in Figure 5 was made using the equipment illustrated in Figure 4. A thermoplastic rubber commercially available under the trade name "Kraton G1657X" from Shell Chemical Company, A Division of Shell Oil Company, Atlanta, GA, was used in the extruder 22 to form the strands 16. About ten strands 16 per inch of that material that had a basis weight of about 40 grams per square meter were extruded at a temperature of 230.5̄ °C (450 degree F) between two sheets 12 and 32 of spunbonded non-woven point bonded material that had a basis weight of 149.75 kg/m^2 (0.5 ounce per square yard) and were commercially available under the trade name "Amoco RFX", identification 9.585A, from Amoco Fabric and Fibers Company, Atlanta Ga. The sheets 12 and 32 of material were corrugated by the pairs of mating corrugating members or rollers 20, 21 and 36, 37 respectively, which pairs of corrugating members were identical and were synchronized to move the ridges 19 and 38 of the corrugating members 20 and 24 in opposed relationship through the nip between the rollers 20 and 36 as is illustrated in Figure 4, and to thereby place the anchor portions 14 and 34 of the sheets 12 and 32 of material opposite each other on the strands 16 as is illustrated in Figure 5. The surface speed of the corrugating members 20 and 36 was 20 feet per minute. The corrugating members 36 and 20 were heated to 108.3̄ °C (230 degree F) and had rough textured surface finishes to assist in holding the sheets 12 and 32 of material along their surfaces between the corrugating members 21 and 37 and the nip between the corrugating members 36 and 20 at which the strands were adhered between the anchor portions 14 and 34 of the sheets 12 and 32 of material. The corrugating members 21 and 37 were heated to 91.6̄ °C (200 degree F) and had a very smooth polished chrome surfaces to facilitate their release from the sheets 12 and 32 of material along the corrugating members 21 and 37. The resultant sheet of material had arcuate portions 13 and 33 that projected from the strands 16 by about 2.5 millimeters, had an overall thickness un-stretched of about 5 millimeters, could be stretched longitudinally of the strands 16 to about 1.8 times its un-stretched length, and did not neck down sideways when it was thus stretched. The resultant sheet of material was very soft and conformable, and was deemed suitable for many uses, including as a side panel on a diaper, as the loop portion of a hook and loop fastener or as a medical wrap.

[0050] Example 6: An sheet-like composite similar to the sheet-like composite 90 illustrated in Figure 16 was

95) have a greater width between said opposite elongate side surface portions (26) along said first sheet bonding locations than between said first sheet bonding locations, and the strands (16,16a-c) are formed around and indented by the arcuate convex surfaces of the anchor portions (14,14a-c) at said first sheet bonding locations to provide firm attachment between said first sheet (12,12a-c) and said strands (16,16a-c,95).

2. A sheet-like composite according to claim 1 further including a second sheet (32) of flexible material having anchor portions (34) thermally bonded at second sheet bonding locations to longitudinally spaced parts of the strands (16,16a-c,95) along said second elongate surface portions (28), and having arcuate portions (33) projecting from said second elongate surface portions (28) of the strands (16,16a-c,95) between said second sheet bonding locations.

3. A sheet-like composite according to claim 1 wherein said first sheet (12,12a-c) is formed of nonwoven fibers that are bonded internally of the sheet (12,12a-c), said fibers being crinkled and compressed within the first sheet (12,12a-c) so that the first sheet (12,12a-c) can be easily expanded by partial straightening of the fibers in the first sheet (12,12a-c) and can allow the sheet-like composite to be expanded past the condition where the major surfaces of the first sheets (12,12a-c) are straightened.

4. A method for forming a sheet-like composite, said method comprising:

- providing a first sheet (12,12a-c) of flexible material,
- forming the first sheet (12,12a-c) of flexible material to have arcuate portions (13,13a-c) projecting in the same direction from spaced anchor portions (14,14a-c) of the first sheet (12,12a-c) of flexible material,
- extruding spaced generally parallel elongate strands (16,16a-c) of molten thermoplastic material that is resilient when cooled onto the anchor portions (14,14a-c) of the first sheet (12,12a-c) of flexible material to form resilient strands (16,16a-c) thermally bonded to and extending between the anchor portions of the first sheet (12,12a-c) of flexible material with the arcuate portions (13,13a-c) of the first sheet (12,12a-c) of flexible material projecting from corresponding elongate side surface portions (26) of the strands (16,16a-c) pressing said strands (16,16a-c) onto the first sheet bonding locations so that said strands (16,16a-c) have a greater width along said first sheet bonding locations than between the first sheet bonding locations, the strands (16,16a-c) are formed around and indented by the arcuate convex surfaces of the anchor portions (14,14a-c) at the first sheet bonding locations to provide firm bonds between the first sheet (12,12a-c) and the strands (16,16a-c) along the entire side surface portions (26) of the strands (16,16a-c) that are closely adjacent the anchor portions (14,14a-c), and
- cooling and solidifying the strands.

5. A disposable diaper or other garment including a sheet-like composite comprising:

- a multiplicity of generally parallel elongate strands (16,16a-c) of resilient thermoplastic material extending in generally parallel spaced relationship, each of said strands (16,16a-c) having opposite elongate side surface portions (26) that are spaced from and are adjacent the elongate side surface portions (26) of adjacent strands (16,16a-c), and each of said strands (16,16a-c) also having corresponding opposite first and second elongate surface portions (18,28) extending between said opposite elongate side surface portions (26), and
- a first sheet (12,12a-c) of flexible material having anchor portions (14,14a-c) thermally bonded at first sheet bonding locations to longitudinally spaced parts of the strands (16,16a-c) along the first elongate surface portions (18), and having arcuate portions (13,13a-c) projecting from said first elongate surface portions (18) of the strands (16,16a-c) between said first sheet bonding locations wherein the bonds between said strands (16,16a-c) and said anchor portions (14,14a-c) at said first sheet bonding locations extend along the entire parts of the side surface portions (26) of the strands (16,16a-c) that are closely adjacent the anchor portions (14,14a-c), said strands (16,16a-c) have a greater width between said opposite elongate side surface portions (26) along said first sheet bonding location than between said first sheet bonding locations, and the strands (16,16a-c) are formed around and indented by the arcuate convex surfaces of the anchor portions (14,14a-c) at said first sheet bonding locations to provide firm attachment between said first sheet (12,12a-c) and said strands (16,16a-c).

6. Equipment adapted for forming sheet-like composite from resilient thermoplastic material and a sheet of flexible material, said equipment comprising:

3. Bahnartiges Verbundmaterial nach Anspruch 1, bei dem die erste Bahn (12, 12a-c) aus Vliesfasern besteht, die im Inneren der Bahn (12, 12a-c) verbondet sind, wobei die Fasern in der ersten Bahn (12. 12a-c) geknickt und zusammengedrückt sind, so daß die erste Bahn (12, 12a-c) durch teilweises Geradestrecken der Fasern der ersten Bahn (12, 12a-c) auf einfache Weise gedehnt werden kann und das bahnartige Verbundmaterial über den Zustand hinaus gedehnt werden kann, in dem die Hauptflächen der ersten Bahnen (12, 12a-c) geradegestreckt sind.

4. Verfahren zum Bilden von bahnartigem Verbundmaterial mit den folgenden Schritten:

- Vorsehen einer ersten Bahn (12, 12a-c) aus flexiblem Material,

- Ausbilden der ersten Bahn (12, 12a-c) aus flexiblem Material mit gebogenen Bereichen (13, 13a-c), die in derselben Richtung von voneinander beabstandeten Verankerungsbereichen (14, 14a-c) der ersten Bahn (12, 12a-c) aus flexiblem Material abstehen,

- Extrudieren voneinander beabstandeter, im wesentlichen paralleler langgestreckter Stränge (16, 16a-c) aus geschmolzenem thermoplastischem Material, das beim Abkühlen auf den Verankerungsbereichen (14, 14a-c) der ersten Bahn (12, 12a-c) aus flexiblem Material elastisch ist, um elastische Stränge (16, 16a-c) zu bilden, die thermisch mit den Verankerungsbereichen der ersten Bahn (12, 12a-c) aus flexiblem Material verbondet sind und sich zwischen diesen erstrecken, wobei die gebogenen Bereiche (13, 13a-c) der ersten Bahn (12, 12a-c) aus flexiblem Material von entsprechenden langgestreckten Seitenflächenbereichen (26) der Stränge (16, 16a-c) abstehen und die Stränge (16, 16a-c) auf die Verbondungsstellen der ersten Bahn drücken, so daß die Stränge (16, 16a-c) entlang den entlang den Verbondungsstellen der ersten Bahneine größere Breite aufweisen als zwischen den Verbondungsstellen der ersten Bahn, und wobei die Stränge (16, 16a-c) an den Verbondungsstellen der ersten Bahn um die gebogenen konvexen Flächen der Verankerungsbereiche (14, 14a-c) herum geformt und von diesen eingedrückt sind, um über die gesamten Seitenflächenbereiche (26) der Stränge (16, 16a-c), die den Verankerungsbereichen (14, 14a-c) eng benachbart sind, eine feste Verbindung zwischen der ersten Bahn (12, 12a-c) und den Strängen (16, 16a-c) zu erzielen, und

- Abkühlen und Verfestigen der Stränge.

5. Wegwerfwindel oder anderes Kleidungsstück mit einem bahnartigen Verbundmaterial, mit:

- einer Vielzahl im wesentlichen paralleler länglicher extrudierter Stränge (16, 16a-c) aus elastischem thermoplastischem Material, die sich im wesentlichen parallel mit gegenseitigem Abstand erstrecken, wobei jeder der Stränge (16, 16a-c) entgegengesetzte langgestreckte Seitenflächenbereiche (26) aufweist, die von den langgestreckten Seitenflächenbereichen (26) benachbarter Stränge (16, 16a-c) beabstandet und diesen benachbart sind, und wobei jeder der Stränge (16, 16a-c) entsprechende gegenüberliegende erste und zweite langgestreckte Flächenbereiche (18, 28) aufweist, die sich zwischen den gegenüberliegenden langgestreckten Seitenflächenbereichen (26) erstrecken, und

- einer ersten Bahn (12, 12a-c) aus flexiblem Material mit beabstandeten Verankerungsbereichen (14, 14a-c), die thermisch an Verbondungsstellen der ersten Bahn (12, 12a-c) mit in Längsrichtung beabstandeten Teilen der Stränge (16, 16a-c) entlang den ersten langgestreckten Flächenbereichen (18) verbondet sind, und mit bogenförmigen Bereichen (13, 13a-c), die von den Strängen (16, 16a-c) zwischen den Verbondungsbereichen der ersten Bahn vorstehen, wobei die Bondstellen zwischen den Strängen (16, 16a-c) und den Verankerungsbereichen (14, 14a-c) in den Verbondungsbereichen der ersten Bahn über die gesamten Teile der Seitenflächenbereiche (18, 28) der Stränge (16, 16a-c, 95) verlaufen, die den Verankerungsbereichen (14, 14a-c) eng benachbart sind, und wobei die Stränge (16, 16a-c, 95) über ihre Länge, einschließlich den Verbondungsstellen, eine gleichmäßige Morphologie aufweisen, wobei die Stränge (16, 16a-c, 95) eine größere Breite zwischen den gegenüberliegenden langgestreckten Seitenflächen (26) entlang den Verbondungsstellen der ersten Bahn aufweisen als zwischen den Verbondungsstellen der ersten Bahn, und wobei die Stränge (16, 16a-c) an den Verbondungsstellen der ersten Bahn um die gebogenen konvexen Flächen der Verankerungsbereiche (14, 14a-c) herum geformt und von diesen eingedrückt sind, um eine feste Verbindung zwischen der ersten Bahn (12, 12a-c) und den Strängen (16, 16a-c) zu erzielen.

6. Einrichtung zum Bilden eines bahnartigen Verbundmaterials aus elastischem thermoplastischem Ma-

ladite première feuille (12, 12a-c) et lesdits brins (16, 16a, 95).

2. Composite analogue à une feuille selon la revendication 1, incluant de plus une deuxième feuille (32) d'une matière flexible ayant des portions d'ancrage (34) thermiquement liées, au niveau d'emplacements de liaison de la deuxième feuille, à des parties longitudinalement espacées des brins (16, 16a-c, 95) le long desdites deuxièmes portions de surface allongées (28), et ayant des portions arciformes (33) se projetant à partir desdites deuxièmes portions de surface allongées (28) des brins (16, 16a-c, 95) entre lesdits emplacements de liaison de la deuxième feuille.

3. Composite analogue à une feuille selon la revendication 1, dans lequel ladite première feuille (12, 12a-c) est formée de fibres non tissées qui sont liées de façon interne dans la feuille (12, 12a-c), lesdites fibres étant plissées et compressées à l'intérieur de la première feuille (12, 12a-c) de sorte que la première feuille (12, 12a-c) peut être facilement allongée par le redressement partiel des fibres dans la première feuille (12, 12a-c) et peut laisser le composite analogue à une feuille s'allonger, passée la condition où les surfaces principales des premières feuilles (12, 12a-c) sont redressées.

4. Procédé pour former un composite analogue à une feuille, ledit procédé consistant:

- à fournir une première feuille (12, 12a-c) de matière flexible;
- à former la première feuille (12, 12a-c) de matière flexible pour qu'elle ait des portions arciformes (13, 13a-c) se projetant dans la même direction à partir des portions d'ancrage espacées (14, 14a-c) de la première feuille (12, 12a-c) de matière flexible;
- à extruder des brins allongés, généralement parallèles, espacés (16, 16a-c) de matière thermoplastique à l'état fondu, qui est élastique quand elle est refroidie, sur les portions d'ancrage (14, 14a-c) de la première feuille (12, 12a-c) de matière flexible pour former des brins élastiques (16, 16a-c) liés thermiquement à et s'étendant entre les portions d'ancrage de la première feuille (12, 12a-c) de matière flexible avec les portions arciformes (13, 13a-c) de la première feuille (12, 12a-c) de matière flexible se projetant à partir des portions de surface latérales allongées correspondantes (26) des brins (16, 16a-c), à presser lesdits brins (16, 16a-c) sur les emplacements de liaison de la première feuille de sorte que lesdits brins (16, 16a-c) ont une largeur plus grande le long desdits emplacements de liaison de la première feuille qu'entre les emplacements de liaison de la première feuille, les brins (16, 16a-c) sont formés autour de et renfoncés par les surfaces convexes arciformes des portions d'ancrage (14, 14a-c) au niveau des emplacements de liaison de la première feuille pour fournir des liaisons fermes entre la première feuille (12, 12a-c) et les brins (16, 16a-c) le long des portions de surface latérales entières (26) des brins (16, 16a-c) qui sont étroitement adjacentes aux portions d'ancrage (14, 14a-c); et
- à refroidir et à solidifier les brins.

5. Couche jetable ou autre vêtement incluant un composite analogue à une feuille comprenant:

- une multiplicité de brins allongés généralement parallèles (16, 16a-c) de matière thermoplastique élastique s'étendant en relation espacée généralement parallèle, chacun desdits brins (16, 16a-c) ayant des portions de surface latérales allongées opposées (26)qui sont espacées de et qui sont adjacentes aux portions de surface latérales allongées (26) des brins adjacents (16, 16a-c), et chacun desdits brins adjacents (16, 16a-c) ayant également des première et deuxième portions de surface allongées opposées correspondantes (18, 28) s'étendant entre lesdites portions de surface latérales allongées opposées (26); et
- une première feuille (12, 12a-c) de matière flexible ayant des portions d'ancrage (14, 14a-c) thermiquement liées, au niveau d'emplacements de liaison de la première feuille, à des parties espacées longitudinalement des brins (16, 16a-c) le long des premières portions de surface allongées (18), et ayant des portions arciformes (13, 13a-c) se projetant à partir desdites premières portions de surface allongées (18) des brins (16, 16a-c) entre lesdits emplacements de liaison de la première feuille dans laquelle les liaisons entre lesdits brins (16, 16a-c) et lesdites portions d'ancrage (14, 14a-c) au niveau desdits emplacements de liaison de la première feuille s'étendent le long des parties entières des portions de surface latérales (26) des brins (16, 16a-c) qui sont étroitement adjacents aux portions d'ancrage (14, 14a-c), lesdits brins (16, 16a-c) ont une largeur plus grande entre lesdites portions de surface latérales allongées opposées (26) le long dudit emplacement de liaison de la première feuille qu'entre lesdits emplacements de liaison de la première feuille, et les brins (16, 16a-c) sont formés autour de et renfoncés par les surfaces convexes arciformes des portions d'ancrage (14, 14a-c) au niveau desdits emplacements de liaison de la première feuille pour fournir une

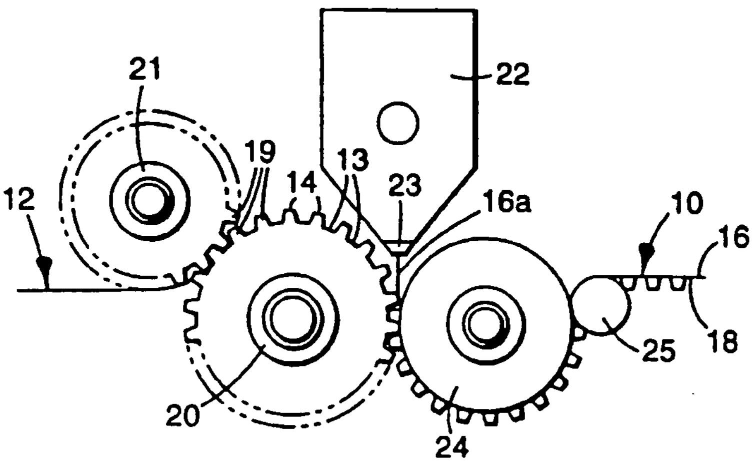

Fig. 1

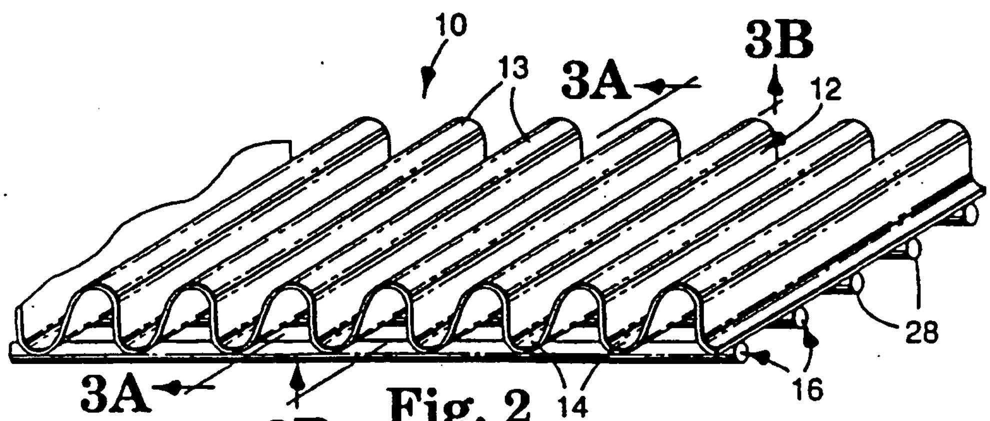

Fig. 2

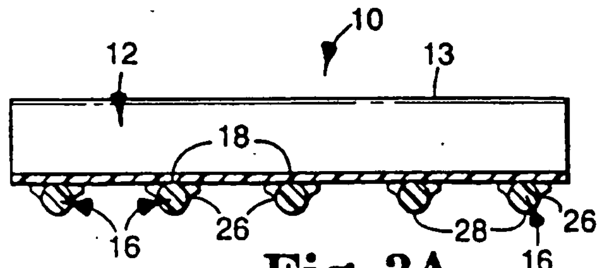

Fig. 3A

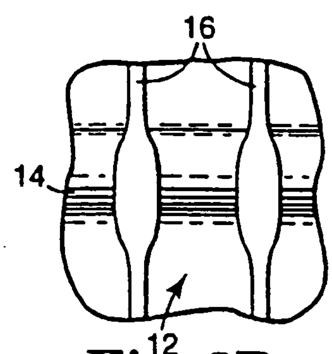

Fig. 3B

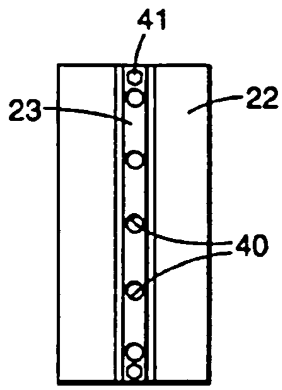

Fig. 7

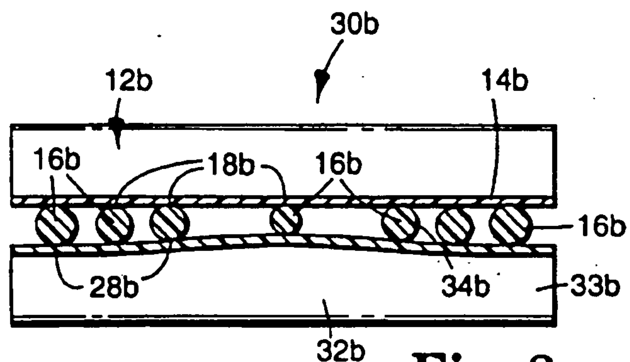

Fig. 8

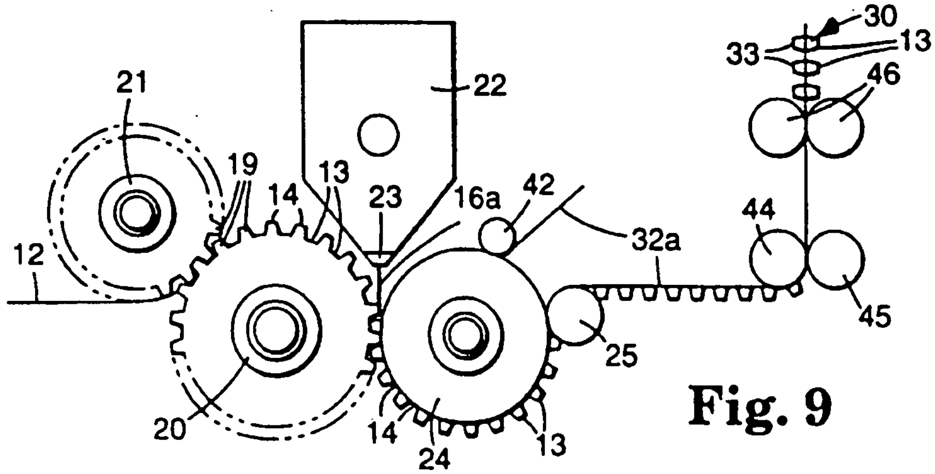

Fig. 9

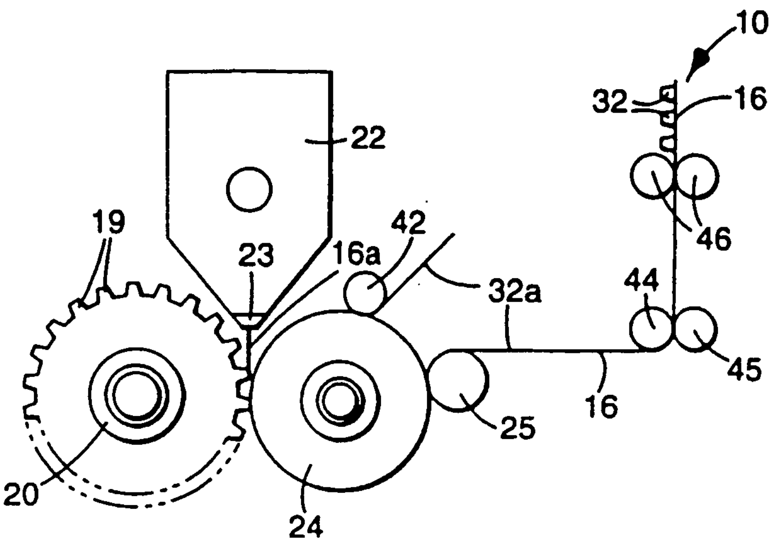
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Fig. 12

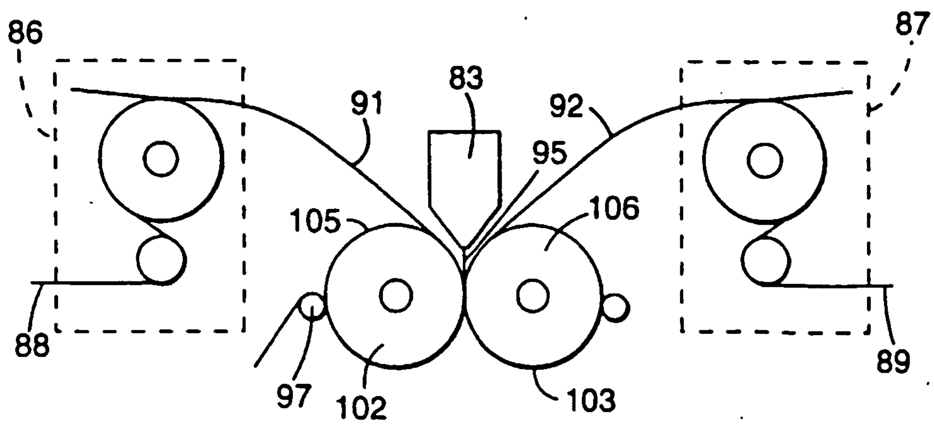
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Fig. 18

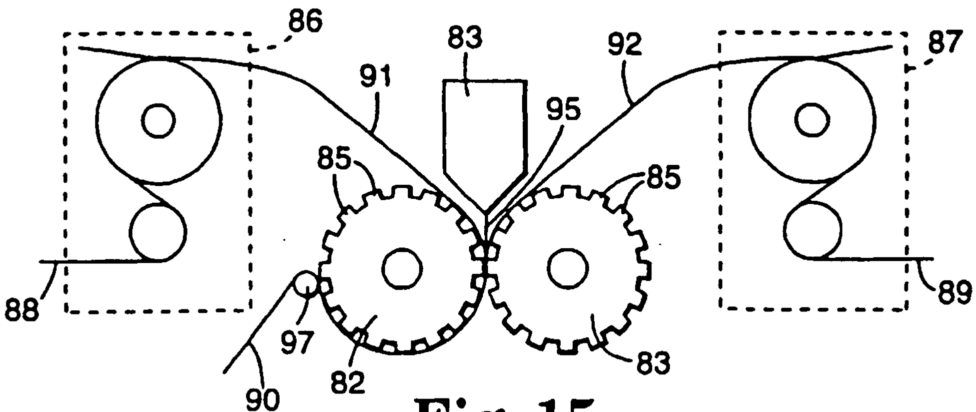

Fig. 15

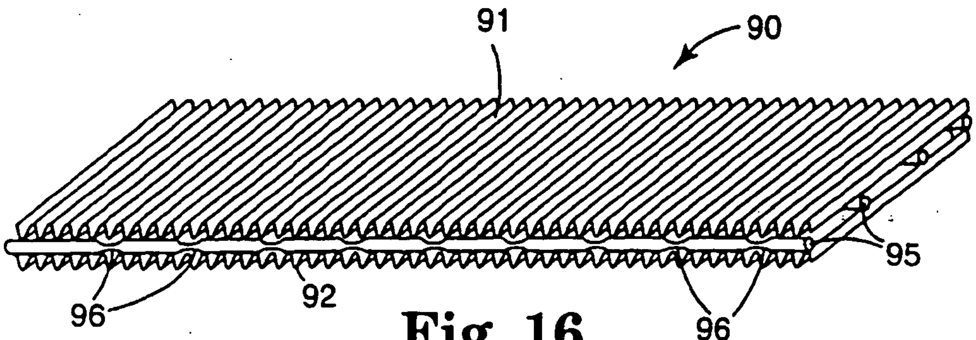

Fig. 16

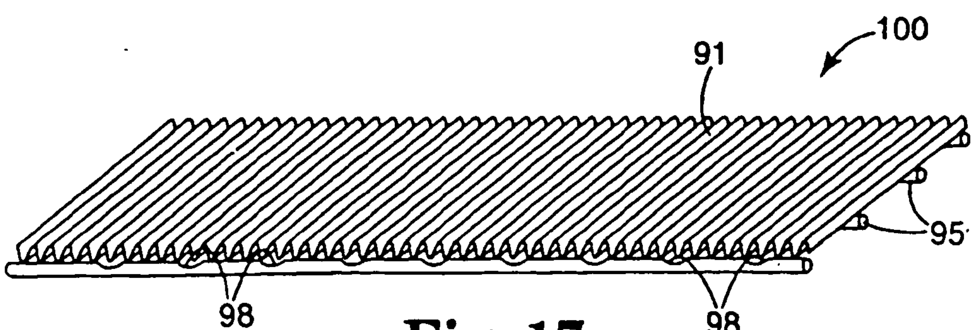

Fig. 17